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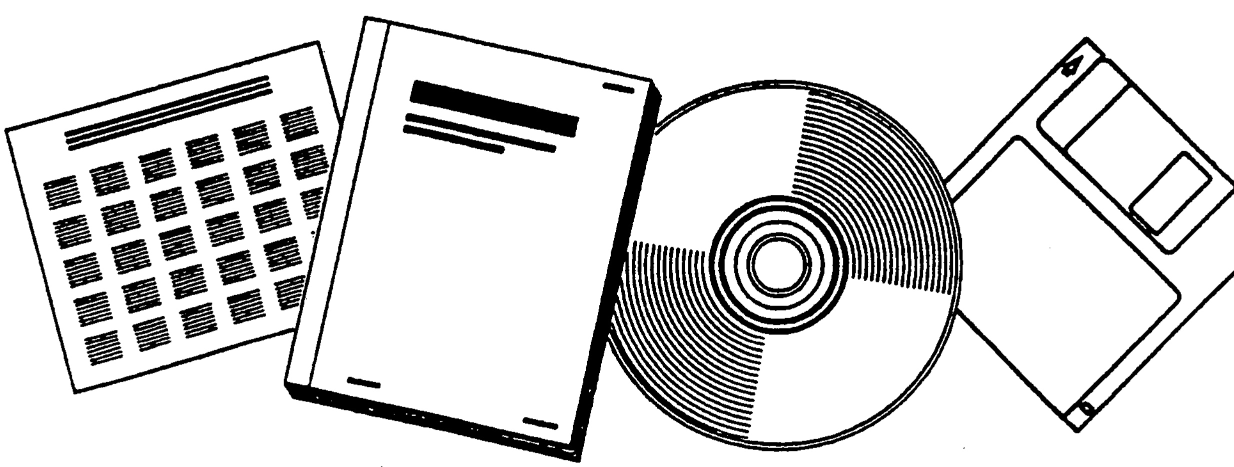
ENVIRONMENTAL ASSESSMENT FOR THE SHIPMENT OF LOW ENRICHED URANIUM BILLETS TO THE UNITED KINGDOM FROM THE HANFORD SITE, RICHLAND, WASHINGTON

DEPARTMENT OF ENERGY, RICHLAND, WA.
RICHLAND FIELD OFFICE

AUG 1992



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Environmental Assessment for the Shipment of Low Enriched Uranium Billets to the United Kingdom from the Hanford Site, Richland, Washington

Date Published
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United States
Department of Energy
P.O. Box 550
Richland, Washington 99352

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1.0 SUMMARY

This Environmental Assessment (EA) provides the necessary information so that a decision can be made on whether a Finding of No Significant Impact should be issued or an Environmental Impact Statement should be prepared for the proposed action. The proposed action is to transfer 2,592 low enriched uranium billets to the United Kingdom. The billets are currently stored in the 300 Area of the Hanford Site, Richland, Washington (see Figures 1 and 2).

The proposed action would consist of two types of activities: loading and transportation. The loading activities would include placing the billets into the appropriate containers for transportation. The transportation activities would include the tasks required to transport the containers 215 miles (344 km) via highway to the Port of Seattle, Washington, and transfer the containers aboard an ocean cargo vessel for transportation to the United Kingdom. The Department of Energy (DOE) would only be responsible for conducting the loading activities. The United Kingdom would be responsible for conducting the transportation activities in compliance with all applicable United States and international transportation laws.

The tasks associated with the proposed action activities have been performed before and are well defined in terms of requirements and consequences. A risk assessment[1] and a nuclear safety evaluation were performed to address safety issues associated with the proposed action. The risk assessment determined the exposure risk from normal operation and from the maximum credible accident* that involves a truck or ship collision followed by a fire that engulfs all the billets in the shipment and the release of the radiological contents of the shipment to the environment. The criticality assessment determined the nuclear safety limits for handling, transporting and storing the shipment under incident-free and accident transport conditions.

Alternatives to the proposed action include (1) No Action, i.e., no shipment of low enriched uranium to the United Kingdom, and (2) several shipping approaches related to other transportation routes, including ocean transportation from several different sea ports.

This EA was prepared in accordance with the Council on Environmental Quality regulations implementing the procedural provisions of the National Environmental Policy Act (40 CFR 1500-1508), the DOE National Environmental Policy Act (NEPA) Order 5440.1D and the DOE NEPA Regulations (10 CFR Part 1021).

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*The maximum credible accident is the most severe reasonably foreseeable accident that is not so remote or conjectural as to preclude meaningful consideration by DOE.

Figure 1. Hanford Site, Washington.

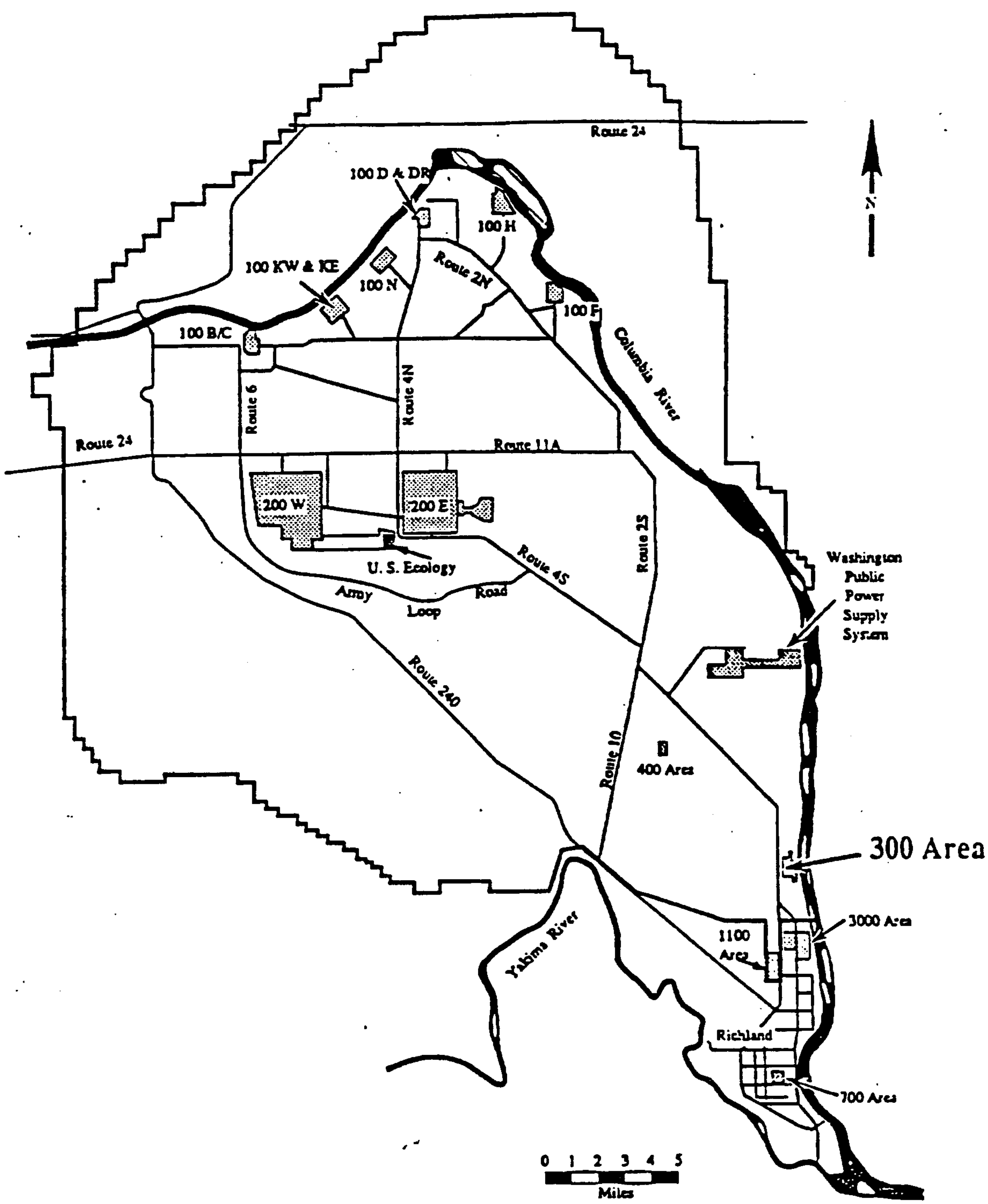

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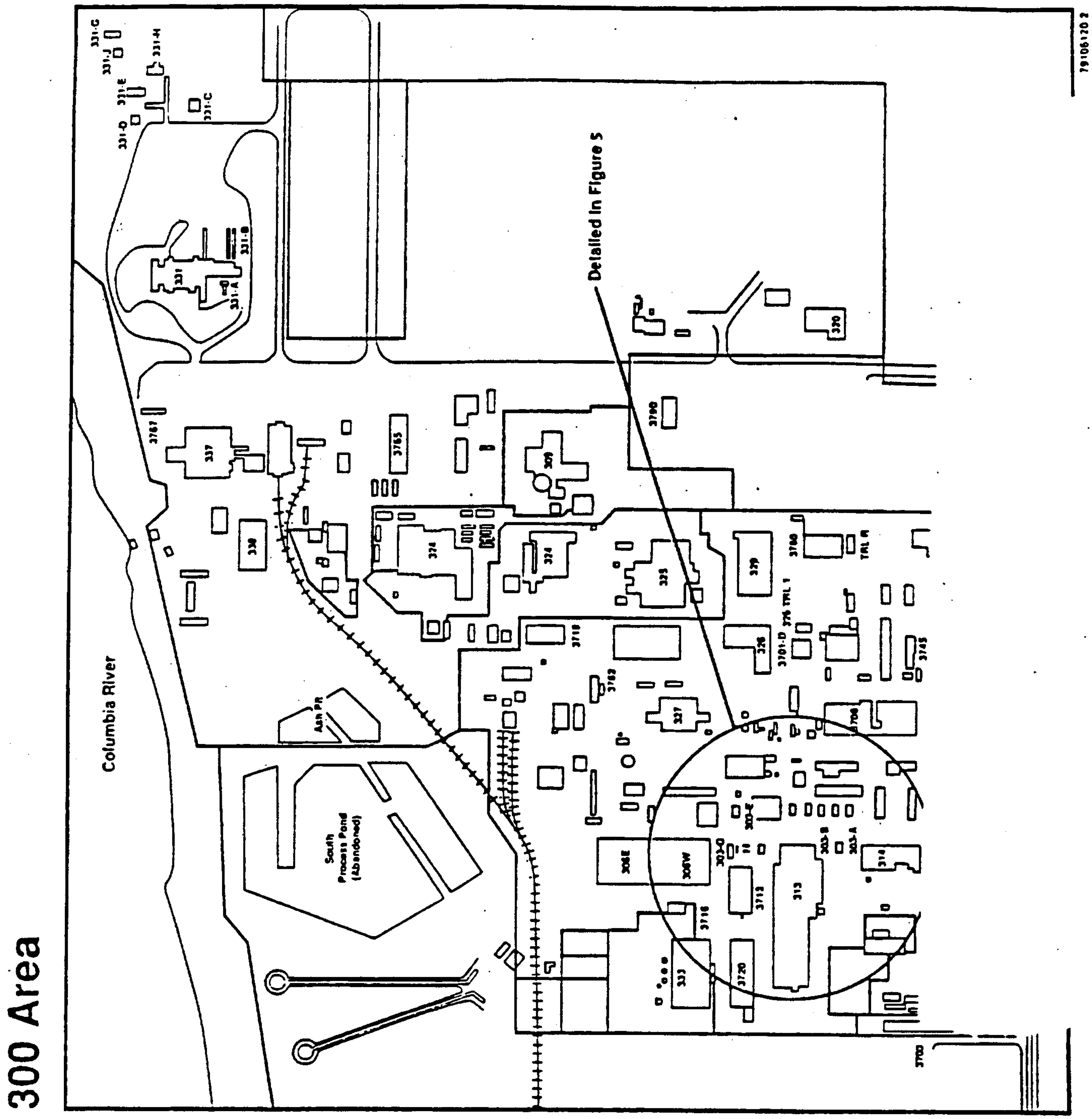
Figure 2. 300 Area, Hanford Site.



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2.0 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

2.1 PURPOSE AND NEED OF THE AGENCY ACTION

The United Kingdom has expressed a need for 2,592 low enriched uranium billets (326 metric tons of uranium). The United Kingdom's need for the billets is associated with the United Kingdom's Defense Nuclear Program which is ongoing under the auspices of an agreement between the United States of America and the United Kingdom. These uranium billets, packaged as stated in Section 2.4, would be shipped as Fissile Exempt[2] (i.e., the billets do not contain enough fissionable material to be classified as fissile and, thus, are exempt from Department of Transportation fissile material requirements) and would be considered Low Specific Activity[3] (i.e., the radioactivity is uniformly distributed in the billets and its estimated average concentration is low enough not to require special packaging under Department of Transportation guidelines).

2.2 PROPOSED ACTION

The proposed action would include loading the packaged billets into closed-type International Standards Organization (ISO) containers, transporting the ISO containers 215 miles (344 km) by truck to the Port of Seattle, Washington, transferring the ISO containers aboard an ocean cargo vessel, and transporting the ISO containers to the United Kingdom. The 2,592 billet transfer would involve 29 truck shipments (each carrying 1 ISO container) and 4 ocean cargo vessel shipments (each carrying between 6 and 8 ISO containers), and would occur over a period of approximately 5 months. The following sections describe the uranium billets and their packaging and discuss the activities included in this action as well as alternatives to this action.

2.3 URANIUM BILLETS

The uranium billets were fabricated for the manufacture of fuel for the Hanford N Reactor, but are now surplus due to the discontinued defense reactor operations at Hanford. The billets are composed of 99.05% U-238 and other trace isotopes by weight and 0.95% U-235 by weight. The billets weigh an average of 280 pounds (127 kg) each and are approximately 20 inches (508 mm) in length, 5 inches (127 mm) in diameter, with an axial hole which measures 1.25 inches (32 mm) in diameter (see Figure 3). The billets are categorized as type X09 and N09 depending on their size and curie content. The 2,592 uranium billets would include 1,887 billets of the type X09 and 705 billets of the type N09. The billets contain a total of 249 curies of uranium and of trace amounts of technetium. The presence of technetium (approximately 0.001% by weight) results from the use of recycled uranium during the billet's manufacturing process. The type X09 billets account for 183 curies and the type N09 billets account for the remaining 66 curies.

2.4 BILLET PACKAGING, ISO CONTAINER AND ISO CONTAINER TRAILER

Each uranium billet is packaged in a Department of Transportation (DOT) Spec 7A metal shipping container drum[4] (see Figure 4). The drums have been banded and placed on special-pallets (nine drums to a pallet). The pallets are located in the loading staging area of the 313 Building (see Figure 5).

The ISO container consists of a ribbed metal box that measures 7.9 feet (2.4 meters) in width by 7.9 feet (2.4 meters) in height by 20.0 feet (6.1 meters) in length (see Figure 6). An ISO container has the capacity to carry 10 pallets in a horizontal 2 x 5 array. The ISO container is attached to the ISO container trailer.

2.5 PROPOSED ACTION ACTIVITIES

The proposed action would be composed of two types of activities. The loading activities would include loading the special pallets which contain the container drums into closed-type ISO containers. The loading activities would be done in the 313 Building.

The transportation activities would include transporting the ISO containers by truck to the Port of Seattle, Washington, and transferring the ISO containers aboard an ocean cargo vessel for transport to the United Kingdom.

Strict compliance with the requirements of DOE contractor operational and radiological procedures developed to control these activities and with local, state and federal laws would be maintained throughout the performance of the following activities to ensure material control, traceability, accountability, and contamination control.

2.5.1 Loading

The loading activities would be performed by DOE contractor workers. The pallet/drums located in the loading staging area of the 313 Building would undergo a final inspection and contamination survey. The pallets/drums would be lifted with a forklift (one at a time), moved into an ISO container, and placed on the floor of the container until the container is filled to capacity (ten pallets). Bracing would be installed as required, and the ISO container doors would be closed and sealed with a tampering indicating device seal. The ISO container would be placarded in accordance with all applicable federal, state and local criteria and the ISO container trailer would be moved to an area near the 313 Building for storage that is appropriately posted in accordance with the DOE contractor radiological control manual.[5]

Figure 3. Uranium Billets, Type X09 and N09.

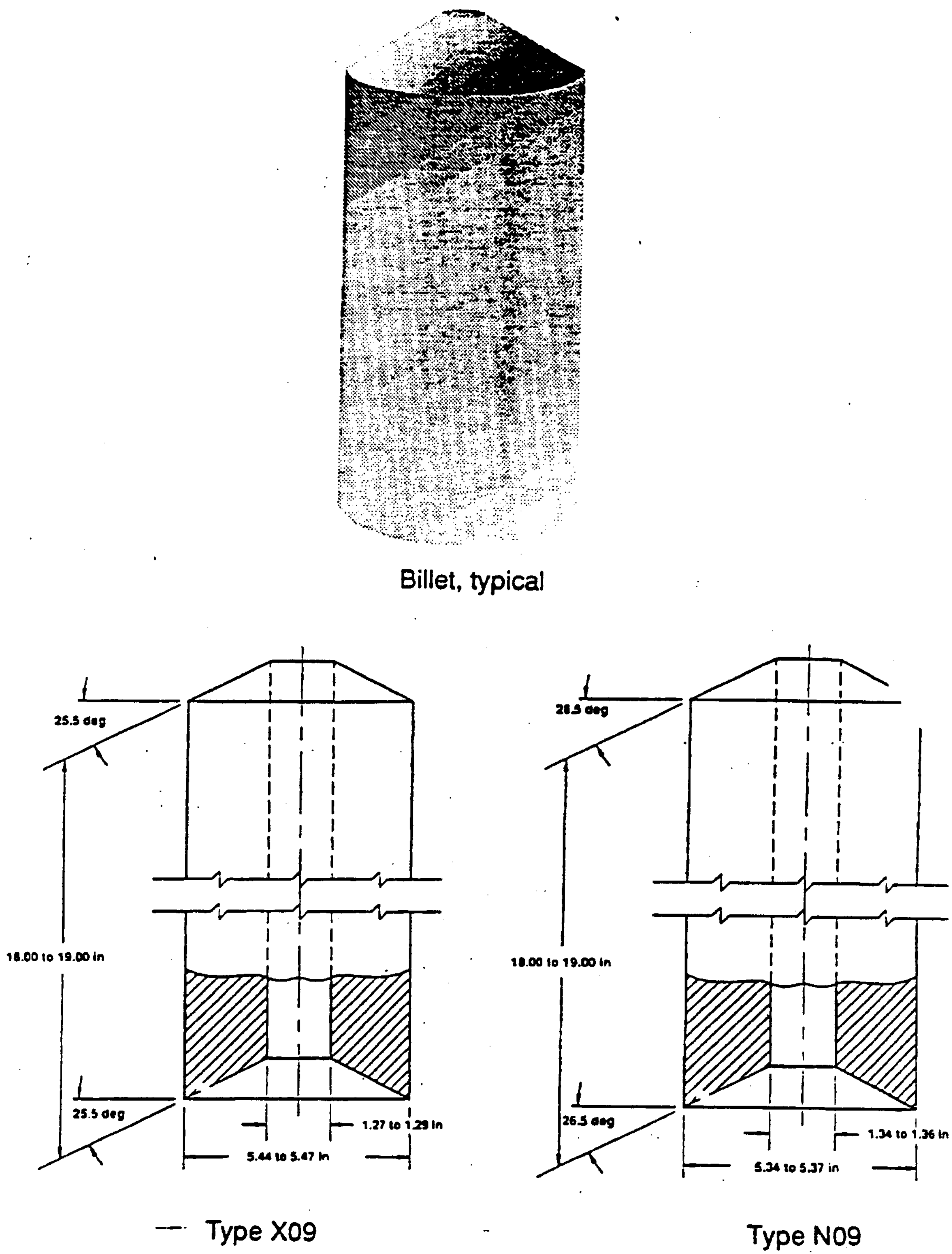
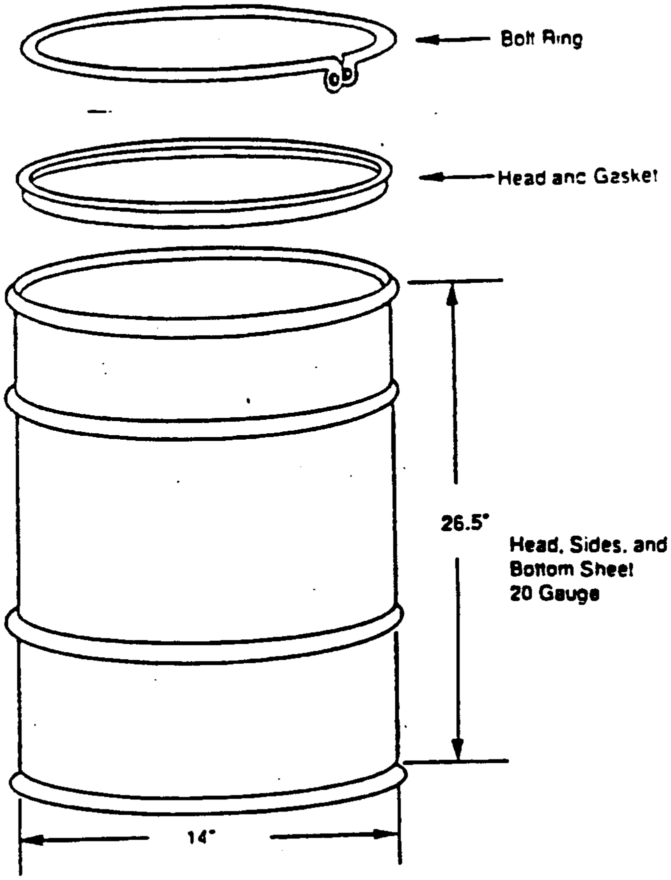
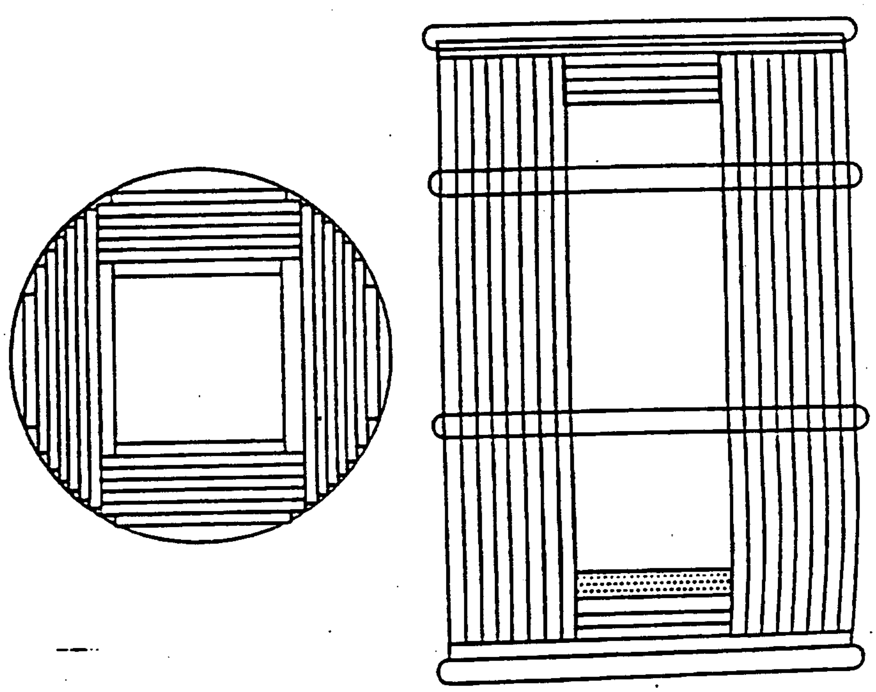


Figure 4. Metal Shipping Container Drum and Packing. DOT Spec 7A.



DOT Spec 7A Drum



DOT Spec 7A Drum Packing

Figure 5. 300 Area N Reactor Fuel Supply Facilities, Billet Storage and Packaging.

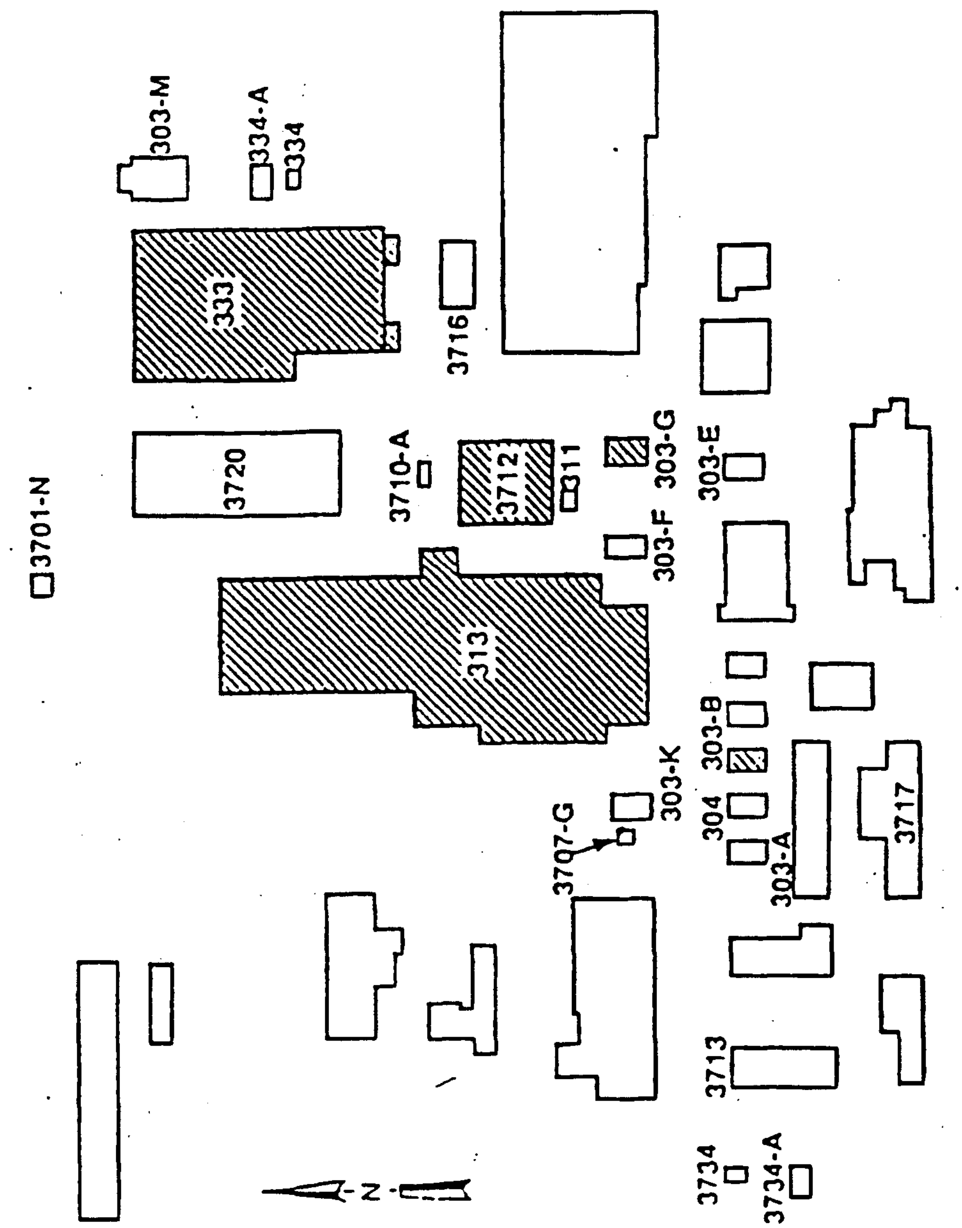


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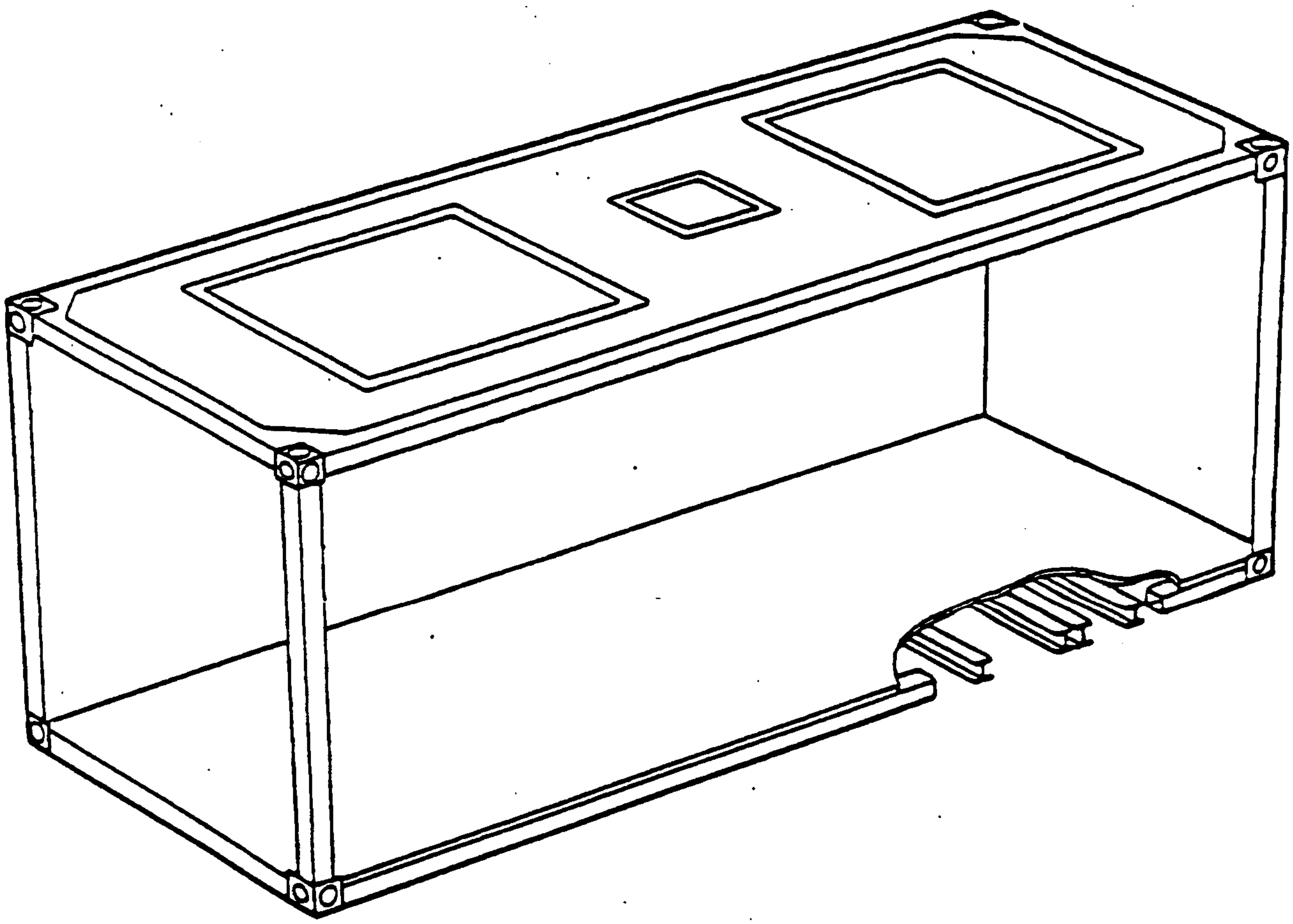
Figure 6. ISO Container



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2.5.2 Transportation

The United Kingdom's workers and contractors would be responsible for performing the transportation activities. Following the transfer of the billets' title to the United-Kingdom via the execution of the appropriate forms, the truck driver would hook up the truck to the ISO container trailer and would inform the Washington State Patrol that the ISO container shipment is leaving the Hanford Site. During periods of inclement weather the driver would also inquire as to road and pass conditions, and any special required precautions.

Upon obtaining the release to leave the 300 Area, the driver would transport the ISO container to the 1167 Building in the 1100 Area (see Figure 1) for final radiation survey, transportation logistics evaluation, and DOE contractor Transportation Department approval for transportation release. The truck driver would then proceed to the Port of Seattle, Washington, in accordance with the provisions of the United Kingdom's transportation plan.[6]

Following arrival at the gate of Terminal 42 in the Port of Seattle (a secured, bonded area with 24 hour security and roving patrols during the night), the driver would exchange interchange agreements with, and transfer custody of the ISO container to, the Terminal personnel. The driver would then call the Washington State Patrol and inform them that the shipment is in the port, and proceed as directed to a designated area within Terminal 42 where the ISO container would be stored until it is ready for loading onto the ocean cargo vessel. After customs clearance the ISO containers would be loaded aboard an ocean cargo vessel and transported to the United Kingdom. The 6 to 8 ISO containers which comprise a shipment would remain in storage for a maximum period of 36 hours.

2.6 ALTERNATIVES

Alternate methods to implementing the proposed action have been identified and are presented in the following subsections. The evaluation of these alternatives is discussed in Section 5.0.

2.6.1 No Action

This alternative is represented by returning the low enriched uranium billets to Buildings 3712, 303-B and 303-G for storage. Active administrative controls and monitoring would continue to be provided. There would not be any low enriched billets transferred to the United Kingdom.

2.6.2 Shipment - Alternate Transportation Routes

This alternative consists of evaluating two alternate transportation routes for transporting the billets to the United Kingdom. Loading of the billets, as discussed in Section 2.5.1, would remain the same.

The first alternate route consists of transporting the ISO containers 265 miles (424 km) by truck to the Port of Portland, Oregon or to the Port of Vancouver, Washington. At the selected port, the ISO containers would be loaded aboard a vessel for ocean transport to the United Kingdom.

The second alternate route consists of transporting the ISO containers 3100 miles (4960 km) by truck to the Port of Portsmouth, Virginia, and transferring them aboard a vessel for ocean transport to the United Kingdom. This alternate route was chosen as a representative bounding case for assessing the potential environmental effects of the transportation activity.

3.0 AFFECTED ENVIRONMENT

This section provides an overview of the environmental characteristics of the Hanford Site and site-specific characteristics of the 300 Area and the Port of Seattle where the major aspects of the proposed action would be performed. This section also briefly describes the environmental characteristics of the alternative ports considered herein. Detailed information about the Hanford Site is provided in References 7 and 8.

3.1 HANFORD SITE/300 AREA CHARACTERISTICS

3.1.1 Site Location and Regional Population

The 313 Building is located in the 300 Area of the approximately 560 square mile (1,450 km^2) Hanford Site in south central Washington (see Figure 1). The 313 Building is approximately 2,200 feet (670 m) from the Columbia River, the nearest natural watercourse. The north boundary of the city of Richland (population 30,500) is about 1.5 miles (2.4 km) to the south of the 313 Building. The 1980 population of adjacent Benton and Franklin counties was estimated to be 144,000; the 1990 population is estimated to be 145,000.[7]

3.1.2 Regional and Site Activities

Major industrial facilities within a 50 mile (80 km) radius include a meat packing plant, food processing facilities, a fertilizer plant, a pulp and paper mill, a chemical plant, hydroelectric dams and small manufacturing firms. Within a 50 mile (80 km) radius of the 300 Area, but outside of the Hanford Site boundary, agriculture is the main land use.

United States Government facilities located on the Hanford Site include the PUREX Facility, PFP Facility, radioactive waste management facilities, nuclear materials storage facilities, research laboratories, and the Fast Flux Test Facility. There are also retired production reactors and retired fuel processing plants on the site.

Commercial use of the Hanford Site includes a nuclear power plant (Washington Public Power Supply System, WNP-2) and a State of Washington administered low-level radioactive waste burial area operated by United States Ecology. The Siemens Nuclear Power Corporation fabrication plant is located adjacent to the Hanford Site south boundary.

3.1.3 Physical Environment

3.1.3.1 Geology-Topography

The Hanford Site is located in the Pasco Basin, one of the structural and topographic basins of the Columbia plateau. Thick basalt flows (up to

16,000 feet [4,900 m] thick) underlie sedimentary material consisting of silts, sands, and gravels (Hanford and Ringold Formations). The Ringold Formation is characteristically about 37 m (121 ft) thick in the 300 area. Drilling logs of the 300 area show approximately 18 m (60 ft) of glaciofluvial sediments overlying the Ringold Formation consist of unconsolidated gravels and sands with some boulders and cobbles. Eolian (wind-transported and wind-deposited) material overlies the glaciofluvial sediments and consists of unsaturated silt and sand. These deposits are typically about 1.8 m (6 ft) thick.[7]

3.1.3.2 Hydrology

The Columbia River, the dominant river in the region, flows through the northern part of the Hanford Site and along its eastern boundary. The 313 Building is .5 mi (.8 km) downstream of the lower boundary of the Hanford Reach Study that was authorized by Public Law 100-605, dated November 4, 1988, to consider alternatives for the protection and preservation of values identified within the study area. Grade level at the 313 Building is 387 ft (118 m) above sea level, which is 17 ft (5 m) above the estimated 100 year flood.

Columbia River water quality is routinely monitored from locations upstream and downstream of the Hanford Site by Pacific Northwest Laboratory (PNL) and the United States Geological Survey. The 1989 monitoring results are provided in Reference 9. Radionuclides associated with Hanford operations are detected, but, concentrations are extremely low and remain well below applicable standards. Nonradiological water quality constituents measured are also in compliance with applicable standards.

Groundwater under the Hanford Site is present under unconfined and confined conditions. The uppermost, unconfined aquifer is contained within the glaciofluvial sands and gravel and the Ringold Formation. The confined aquifers consist of sedimentary interbeds and interflow zones that occur between dense basalt flows in the Columbia River Basalt Group. Sources of natural recharge to the unconfined aquifer are rainfall, runoff from the higher bordering elevations, water infiltrating from small ephemeral streams, and influent river water. Groundwater in the 300 Area is found at approximately 40 feet (12 m) below grade.[7] The groundwater generally flows toward the river to the southeast and east. It is routinely monitored by PNL and results are reviewed to detect abnormalities.

3.1.3.3 Seismicity

The Hanford Site is located in an area of moderate seismicity.[8] The largest earthquake of record to occur within the Columbia Basin was the 1936 Milton-Freewater earthquake that had a magnitude of 5.75 on the Richter Scale and has been designated the Hanford Regional Historical Earthquake (HRHE). This HRHE is assumed to have a peak horizontal ground acceleration of 0.10 g.[10]

3.1.3.4 Climatology

The climate at the Hanford Site is semiarid and is characterized by relatively cool, mild winters and warm summers. The average maximum temperatures for January (the coldest month) is 36° F (2° C); for July (the warmest month) average maximum temperature is 95° F (35° C). The average annual precipitation at the Hanford Site is 6 in. (16 centimeters).[7]

The prevailing winds are from a southwesterly direction. Tornadoes rarely occur in the Hanford Site region and those few sighted have been small and have not caused damage. Existing data indicate that the probability of a tornado hitting a particular structure at the Hanford Site is about 10 times in a million years.[8]

3.1.3.5 Air Quality

Airborne particulate concentrations can reach relatively high levels in eastern Washington State because of exceptional natural events (i.e., dust storms, volcanic eruptions, and large brush fires) that occur in the region.[7]

3.1.4 Ecology

The Hanford Site is located in a semiarid region consisting of large areas of undeveloped land, including abandoned agricultural areas, and widely separated clusters of industrial buildings. The plant and animal species on the Hanford Site are representative of those inhabiting the shrub-steppe (sagebrush-grass) region of the northwestern United States.[7]

An ecological resources review would not be necessary, because all activities would take place within the 313 Building, Hanford Site waste handling facilities, and on existing roads.

3.1.5 Archaeology

A cultural resources review would not be necessary before initiation of any activities, because the proposed activities would occur solely within the 313 Building, Hanford Site waste handling facilities, and on existing roads.

3.2 PORT CHARACTERISTICS

3.2.1 Port of Seattle, Washington

The port locale for the proposed action is Seattle, Washington. The Port of Seattle is located within the city limits of the city of Seattle in the state of Washington. The port is situated to the immediate west of Seattle on Elliott Bay which connects the city to the Puget Sound. The port is controlled and operated by a port commission with members selected by county election.

The Port of Seattle is the fifth largest container port in the United States. In addition to container cargo, the port also handles other forms of goods, such as grain, automobiles, chilled goods, and steel. In 1991, 12.7 million metric tons of cargo were moved through the port, of which approximately 8 million metric tons were container cargo. There are 25 commercial terminals located on 345 acres. There is excellent access to the port from interstate highways - the port is located at the confluence of I-5 and I-90.

The population of the city of Seattle is more than 516,000 people based on the 1990 Census data. King County, which includes Tacoma and Everett, is the home for approximately 1.3 million people. This relates to a population density in the city of Seattle of 2318 people per square kilometer (6003 people per square mile).

3.2.2 Port of Portland, Oregon

The port locale for the first alternative to the proposed action is Portland, Oregon. The Port of Portland is located within the city limits of the city of Portland, Oregon. The Port has four terminals located on the Willamette River and one located on the Columbia River. The population density of Portland, Oregon, is 1254 people per square kilometer (3507 people per square mile).

3.2.3 Port of Portsmouth, Virginia

The port locale for the second alternative to the proposed action is Portsmouth, Virginia. The Port of Portsmouth is located at the mouths of the James and Elizabeth Rivers at the base of the Chesapeake Bay. The population density of Portsmouth, Virginia, is 2000 people per square kilometer (5180 people per square mile).

4.0 ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

The primary impact of the proposed action has been determined to be the occupational radiation exposure that would be received by workers during the performance of the proposed action activities. The radiation exposure received by DOE contractor workers would be controlled below DOE limits as defined in DOE Orders 5480.11[11] and 5484.1.[12] Those limits control individual radiation exposure to below an effective dose equivalent (EDE) of 3 rem/quarter and an annual maximum of 5 rem/yr. The DOE contractor exposure limits are more restrictive and would be used during this proposed action to control individual whole-body radiation exposure to less than 2 rem/year. See Sections 4.1.3 and 4.2.3 for a detailed discussion on radiation exposure.

Risks to DOE contractor workers from other hazards, such as weather exposure, heat exhaustion, and falls or trips, were also considered. These hazards would be minimized by the routine DOE contractor industrial safety programs and the training each worker receives before working at the facility. These actions generally result in a low risk to routine industrial safety hazards.

Risks of occupational radiation exposure and other hazards to United Kingdom's workers and contractors involved with the shipment would be controlled in accordance with all the applicable United States and international transportation laws.

Environmental impacts from the proposed action have been grouped into those that result from the performance of the loading activities and those that result from the performance of the transportation activities. A discussion of these impacts follows.

4.1 IMPACTS ATTRIBUTABLE TO LOADING ACTIVITIES

The loading activities included in the proposed action would be performed by DOE contractor workers and would consist of placing the special pallets/drums into the ISO containers for transport. These activities and the training of workers in the operation of the equipment would be conducted in the loading staging area of the 313 Building.

The worker radiation exposure dose rate for the activities performed in the 313 Building would be 0.50 mrem/hr. This dose rate includes the building's work areas dose rate and the drum's dose rate at a distance of one meter from the drum. No extraordinary exposure reduction actions are planned at the present time because of the low expected radiation dose rates resulting from the performance of these activities. Cumulative radiation exposure for each individual worker would be tracked daily and actions would be taken, as appropriate, to maintain the radiation exposures to As Low As Reasonably Achievable (ALARA) levels.

Detailed written procedures would be prepared specifically for the loading activities and would be followed for all work conducted in the buildings. These procedures would ensure the proper ALARA[13] considerations are implemented. No radionuclide or hazardous material releases to the atmosphere would result from the performance of these activities.

Dust and noise normally associated with these activities would not exceed industrial standards, and workers would use protective clothing and equipment to minimize safety hazards in accordance with established DOE contractor practices and procedures. No air or water emissions are expected as a result of this activity. Other impacts are discussed below.

4.1.1 Waste Generation

The performance of the loading activities would not generate any nonhazardous/nonradioactive solid waste; nonhazardous/low-level radioactive solid waste; hazardous; or mixed waste.

4.1.2 Worker Health

During the performance of these activities, workers would be exposed to occupational health risks. To ensure that the risks are kept to a minimum, workers involved in these activities would wear protective clothing. All work areas would be surveyed by Health Physics technicians to identify the contamination and radiation levels and define any work restrictions before work is started. Special work permits, reviewed by Industrial Safety personnel and Health Physics technicians, would be required to ensure that all worker hazards have been identified and that all necessary precautions have been taken to protect workers.

Workers would be specifically trained in the importance and use of protective clothing, ALARA considerations, and job specific requirements. Industrial Safety personnel and Health Physics technicians would closely monitor the work to ensure that the required protective devices are being used correctly, and that workers are appropriately protected.

4.1.3 Radiological Exposure Consequences

Radiological exposure consequences are those associated with the radioactive nature of the low enriched uranium billets. These consequences address the radiation exposure received by DOE contractor workers and the general public during the performance of the activities identified in Section 2.5.1. The consequences are categorized under normal and accident loading conditions.

4.1.3.1 Normal Loading Conditions

Under normal loading conditions it is postulated that it would take a work force of 2 persons a total of 174 hours to complete all the loading activities for the 2,592 billets. Worker training would take an additional 26 hours.

Calculations[14] were performed to estimate the potential radiological exposure consequence resulting from the performance of the loading activities for the 2,592 billets. The radiological exposure consequence, under normal loading conditions, was estimated by multiplying the worker radiation exposure dose rate in the 313 Building by the time the activities are expected to take in each building by the number of workers required to perform the activities.

The results of the calculations indicate that under normal loading conditions the exposure consequence resulting from implementing the loading activities of the proposed action would be a collective dose equivalent of 1.0×10^{-1} person-rem to the DOE contractor workers. No radiation exposure would be received by the general public because the work area is a radiation exposure area which is restricted to DOE contractor workers only.

Collective dose equivalent values may be converted to estimates of health effects, expressed in terms of latent cancer fatalities (LCF), by using a conversion factor of 1 person-rem = 4.0×10^{-4} LCF. The EPA has used this conversion factor in a recent rule making, based on a review of the best available information at the time.[15] Based on this conversion factor, the collective dose equivalent of the 1.0×10^{-1} person-rem estimated above would result in 4.0×10^{-5} LCF. Based on these results and on the small number of workers involved, no latent cancer fatalities associated with the proposed action would be expected over the workers' lifetimes. Further, no health effects would be incurred by the general public.

4.1.3.2 Accident Loading Conditions

Under accident loading conditions, several accident scenarios were postulated and evaluated. It was determined that the only accident that could cause the total or fractional release of the radiological contents of the drums' cargo to the environment would be an accident that results in an explosive fire which would in turn engulf the drums and cause the billets to burn. This accident is not reasonably foreseeable because there are no combustibles in the planned loading route from the billet storage area to the loading dock, or in the loading equipment, which could be ignited during the performance of this operation. Thus, it is not expected that there could be any accident during loading that would result in additional radiation exposure to the DOE contractor workers or the general public.

4.1.4 Nonradiological Consequences

Nonradiological consequences are those injuries and fatalities that could result from job-related accidents, such as falls, weather exposure, or heat exhaustion. These consequences would be mitigated to the greatest extent possible by established safety programs that are based on DOE requirements[16] and good industrial practice.

4.2 IMPACTS ATTRIBUTABLE TO TRANSPORTATION ACTIVITIES

The United Kingdom would be responsible for the transportation of the uranium billets from the 300-Area to the United Kingdom. The transportation activities of the proposed action would consist of those activities which must be performed to transport the low enriched uranium billets to the United Kingdom via the Port of Seattle, Washington. The activities are described in Section 2.5.2. The proposed action would include the shipment of 326 metric tons of low enriched uranium in billet form. The 2,592 billets, which have been packaged and placed on special pallets as stated in Section 2.5.1, would be loaded into ISO containers that have a capacity of 10 pallets. Twenty-nine ISO containers would be required to transport the 2,592 billets. The ISO containers would be transported by truck (1 ISO container per truck) to the Port of Seattle, Washington by the following route:

- Washington State Road SR-240 to
- Washington State Road SR-243 to
- Washington Interstate I-90 to
- Washington Interstate I-405 to
- Washington Interstate I-5 to
- Seattle city streets to
- Port of Seattle

The above represents the normal route. In the event of road work or some other obstruction, the responsible highway authority might post a detour directing traffic onto a portion of another highway or freeway.

Following the loading of the ISO containers aboard an ocean cargo vessel, the ISO containers would be transported through the Puget Sound and U.S. territorial waters to the United Kingdom[1]. A maximum of 4 ocean trips are planned to transport the 29 ISO containers to the United Kingdom.

Two types of risks are attributable to the transportation activities of the proposed action. The risks have been classified as radiological exposure and nonradiological depending on the source of the risks. Radiological exposure risks have been further grouped under incident-free and accident transport conditions depending on the severity of a potential accident. Definitions of the risks follow:

- Radiological Exposure Risks - Risks expected during the performance of the transportation activities which result from the radioactive nature of the shipment being transported.
  - Incident-Free Transport Conditions - Risks (radiological exposure) to the general public and workers under non-accident conditions or under accident conditions without a radiological release.
  - Accident Transport Conditions - Risks to the population (general public and workers) under accident conditions which result in the release of the radiological contents or fractions thereof of the shipment to the environment.

- Nonradiological Risks - Risks expected during the performance of the transportation activities which are independent of the radioactive nature of the shipment being transported. These risks include injuries and fatalities from in-transit traffic (truck and ship) accidents and from the exhaust emissions of the truck.

The radiological exposure and nonradiological risks associated with the transportation activities are discussed in Sections 4.2.3 and 4.2.4. Other impacts are discussed below.

4.2.1 Waste Generation

The performance of the transportation activities would not generate any nonhazardous/nonradioactive solid waste; nonhazardous/low-level radioactive solid waste; hazardous; or mixed waste.

4.2.2 Worker Health

During the performance of the transportation activities, United Kingdom's workers and contractors would be exposed to occupational health risks. The United Kingdom would be responsible for ensuring that its workers and contractors comply with the Federal Motor Carrier Safety Regulations[17] in order to minimize these risks.

4.2.3 Radiological Exposure Risks

Radiological exposure risks are the possibilities of radiation exposure to transportation workers (United Kingdom's workers and contractors) and the general public associated with incident-free and accident transport conditions during the performance of the transportation activities identified in Section 2.5.2.

A risk assessment[1] was performed to estimate the potential radiological exposure and nonradiological risks resulting from the performance of the transportation activities for the 2,592 billets. The risk assessment used the RADTRAN computer code to determine the transportation risks associated with truck and ocean cargo vessel shipments. The code was originally developed by Sandia National Laboratories in 1976 to calculate the risks associated with the transport of research reactor spent fuel. The results were documented in the Final Environmental Statement of the Transportation of Radioactive Material by Air and Other Modes.[18] The RADTRAN code consists of two major modules: the incident-free transport module, in which exposures resulting from normal transport are modeled, and the accident transport module, in which probabilities and consequences of accidents resulting in radiological releases are evaluated and used to generate a risk estimate.

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The code has been revised several times. RADTRAN IV, the most current version of the code, was used in the risk assessment. This version has been validated and verified; however, since a public reference document is not yet available, this EA references the RADTRAN III code version[19] for information purposes. A detailed description of the data, parameters, modeling techniques, accident severity categories and their associated probabilities of occurrence, accident rates for different population zones, and internal/external exposure pathways for people is presented in the risk assessment. The risk assessment expresses the impacts associated with the transportation activities calculated by the RADTRAN code in terms of risk, risk being defined as the product of the probability of the occurrence of an event involving radioactive materials times the consequences of the event.

The risk assessment includes the analyses of the impacts associated with the transportation activities of the proposed action and of the two alternate transportation routes. The latter analyses were performed to provide a comparison of the impacts associated with the three transportation routes.

To model the transport of the uranium billets from the Hanford Site to the port of departure and on to the bounds of U.S. territorial waters, each transportation route was divided into eight shipping links. These links were then assigned specific properties including:

- Population and vehicle density for the zone being traveled (rural, suburban, or urban);
- Distance traveled in each zone; and
- Average travel speed of the truck/ship through each zone.

The transportation route of the proposed action included the following links:

- Truck transport on Washington roads through rural population zones;
- Truck transport on Washington freeways through rural population zones;
- Truck transport on Washington freeways through suburban population zones;
- Truck transport on Washington freeways through urban population zones;
- Truck transport on Seattle city streets through urban population zones;
- Ship transport on inland waters through rural population zones;
- Ship transport on open sea waters through rural population zones; and

- o Ship transport on in-harbor waters through urban population zones.

Finally, the following assumptions bounded the risk assessment analyses:

- o The loading activities at the Hanford Site are not included in the analyses.
- o Each truck would transport 1 ISO container at a time and 29 truck runs would be required for the entire transfer.
- o The truck crews would consist of one person per truck.
- o Truck stops would be made for resting, refueling, and inspection as required in route to its destination.
- o The loading of the ISO containers into the ocean cargo vessel is included in the analyses.
- o Each ocean cargo vessel would transport six to eight ISO containers and four shipments would be required for the entire transfer.
- o Under incident-free transport conditions, the people that would be at risk to external radiation include:
  - Those residing within approximately 0.5 miles of either side of the transportation route;
  - Those standing beside the road when the truck passes; and
  - The occupants of a passenger car driving beside, in front of, or behind the truck.

4.2.3.1 Incident-free Transport Conditions. The results of the risk assessment indicate that under incident-free transport conditions, the exposure risk resulting from implementing the transportation activities of the proposed action would be 50.40×10^{-2} person-rem to the United Kingdom's workers and contractors and 1.36×10^{-2} person-rem to the general public as a result of the transfer. These exposure risks correspond to 201.60×10^{-6} LCF to the United Kingdom's workers and contractors and 5.44×10^{-6} LCF to the general public.

The probability of an accident on the seas which does not result in the release of radioactive material to the environment has been identified to be between 1.53×10^{-8} and 3.05×10^{-8} accidents per kilometer.[1] This rate equates to a maximum of 1.59×10^{-5} accidents per ocean shipment or 6.37×10^{-5} accidents for the entire transfer. However, since the accident does not result in the release of any radioactive material to the environment, the injuries and fatalities associated with this type of accident are not considered a radiological risk.

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4.2.3.2 **Accident Transport Conditions.** A maximum credible accident was postulated specifically for the transportation activities of the proposed action. The accident consists of a truck or ship collision which engulfs the entire shipment of billets (90 billets in 1 ISO container per truck collision; 720 billets in 8 ISO containers per ship collision) in a fire, thus providing the maximum radiological release to the public. It should be noted that this accident is dependent on the number of ISO containers that the truck or ship would transport, not on the total number of billets being transferred under the proposed action.

The results of the risk assessment indicate the entire population would be subject to a risk of 31.80 person-rem (127.20×10^{-4} LCF) as a result of the transfer. This risk is the sum of the risk associated with each of the eight links which comprise the transportation route of the proposed action.

The probability of an accident on the seas which results in the release of radioactive material to the environment has been defined to be between 1.00×10^{-9} and 1.00×10^{-10} accidents per kilometer.[1] This rate equates to a maximum of 5.22×10^{-7} accidents per ocean shipment or 20.88×10^{-7} accidents for the entire transfer. In the unlikely event of an accident, the volume of material that could be released from the shipping containers is small relative to the volume of ocean water, and hence, dilution and dispersion would be significant. Therefore, the risk to the public due to transport on the high seas is not a significant contributor to the total risk.

4.2.3.3 **Total Radiological Exposure Risk.** The total radiological exposure risk to the population that results from the performance of the transportation activities of the proposed action would be the sum of the risks estimated under the incident-free and accident transport conditions. Accordingly, the total radiological risk to the population would be 32.32 person-rem (129.27×10^{-4} LCF) as a result of the transfer. Table 1 summarizes these results.

Table 1.[1] **Total Radiological Exposure Risk of the Proposed Action**

Transport Condition	Radiological Exposure Risks					
	United Kingdom's Workers and Contractors		General Public		Total	
	Person-Rem $\times 10^{-2}$	LCF $\times 10^{-6}$	Person-Rem $\times 10^{-2}$	LCF $\times 10^{-6}$	Person-Rem	LCF $\times 10^{-4}$
Incident-Free	50.40	201.60	1.36	5.44	0.52	2.07
Accident					31.80[1]	127.20[1]
Total					32.32	129.27

(1) Includes United Kingdom's workers and contractors, and general public.

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4.2.4 Nonradiological Risks

Nonradiological risks are the possibilities of injuries and fatalities that could result from traffic accidents and routine exhaust emissions during the highway and ocean transit of the billets. These risks are not associated in any way with the radioactive nature of the billets. They are the estimated injuries and fatalities that could occur during the transportation of any type of industrial cargo. The nonradiological risk model used in the risk assessment assumes that these risks would occur during both the highway transport segment and the ocean transport segment of the transportation activities. The model uses the same shipping link divisions and properties as used in the radiological risk model. The risk assessment assumes that the nonradiological accident rates associated with the transportation of the low enriched uranium billets by truck and ship are similar to the accident rates associated with the transportation of non-radioactive heavy commodities by truck and ship in the United States.

The results of the risk assessment indicate that the implementation of the proposed action could result in 7.31×10^{-3} injuries and in 5.61×10^{-4} fatalities as a result of the transfer. These results include the injuries and fatalities associated with an accident which occurs under incident-free transport conditions. The results further indicate that the exhaust emissions from the transport trucks could contribute 0.72×10^{-4} LCF. Based on these results, no latent cancer fatalities associated with the transportation activities of the proposed action are expected over the population's lifetimes.

4.3 NUCLEAR SAFETY EVALUATION

A nuclear safety evaluation[20] was also performed to determine if the uranium billet shipments have sufficient controls and safety factors to prevent a nuclear chain reaction under normal loading conditions, incident-free, and accident transport conditions. The analyses addressed the various billet types in their planned configuration in the ISO container and assumed the worst accident conditions that could be imposed on the shipment. The analyses used the industry accepted, certified and validated WIMS-E[21] and MCNP[22] computer codes.

The results of the evaluation indicate that there are sufficient controls and safety factors to prevent a nuclear chain reaction under normal loading conditions, incident-free and accident transport conditions.

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5.0 EVALUATION OF ALTERNATIVES

This section evaluates the alternatives to the proposed action: (1) no action and (2) use of alternate transportation routes to transfer the billets to the United Kingdom. It should be noted that the routing of the billet shipments to the United Kingdom from the Hanford Site is the option of the United Kingdom's shipping agent, not DOE. The United Kingdom's shipping agent has selected the transportation route addressed by the proposed action in accordance with the Department of Transportation Routing Regulations (49 CFR 177). This is the preferred route for effecting the billet transfer because it results in the lowest radiological exposure and nonradiological risks.

5.1 NO ACTION

The No Action alternative entails the continued storage of the billets in their current location. This alternative is unacceptable because it would not meet the need of shipment to the United Kingdom.

5.2 SHIPMENT - ALTERNATE TRANSPORTATION ROUTES

Two alternate transportation routes were evaluated as alternatives to the transportation route of the proposed action. The first route consists of transporting the ISO containers 265 miles (424 km) by truck to the Port of Portland, Oregon/ Port of Vancouver, Washington. At the selected port, the ISO containers would be transferred aboard an ocean cargo vessel for transport to the United Kingdom. The second route consists of transporting the ISO containers 3100 miles (4960 km) by truck to the Port of Portsmouth, Virginia and transferring them aboard an ocean cargo vessel for transport to the United Kingdom.

As stated in Section 4.2.3, the risk assessment[1] estimated the potential radiological exposure and nonradiological risks associated with transporting the billets through the alternate transportation routes. The alternate transportation routes were modeled in a manner consistent with the one used to model the transportation route of the proposed action. For the Port of Portland, Oregon/Port of Vancouver, Washington transportation route, the assessment provides the risks associated with transporting the billets to the Port of Portland. These risks are considered to be representative for the two ports due to their close proximity and location in the same metropolitan area.

Table 2 and Table 3 summarize the radiological exposure and nonradiological risks for the transportation route of the proposed action (shaded) and for each of the alternate transportation routes. A review of the results leads to the conclusion that the risks associated with any of the three transportation routes are small and that the transportation route of the proposed action results in the lowest risk to the population.

Table 2.[1] Total Radiological Exposure Risks for the Three Transportation Routes

Port of Departure	Transport Conditions	Radiological Exposure Risks					
		United Kingdom's Workers and Contractors		General Public		Total	
		Person-Rem $\times 10^{-2}$	LCF $\times 10^{-6}$	Person-Rem $\times 10^{-2}$	LCF $\times 10^{-6}$	Person-Rem	LCF $\times 10^{-4}$
Seattle, Washington	Incident-Free	50.40	201.60	1.36	5.44	0.52	2.07
	Accident					31.80[1]	127.20[1]
	Total					32.32	129.27
Portland, Oregon/ Vancouver, Washington	Incident-Free	52.30	209.20	1.51	6.04	0.54	2.15
	Accident					39.20[1]	156.80[1]
	Total					39.74	158.94
Portsmouth, Virginia	Incident-Free	176.00	704.00	8.66	34.64	1.85	7.39
	Accident					94.40[1]	377.60[1]
	Total					96.25	384.99

(1) Includes United Kingdom's workers and contractors, and general public.

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Table 3.[1] Total Nonradiological Risks of the Three Transportation Routes

Port of Departure	Injuries x 10^{-4}	Fatalities x 10^{-4}	Latent Cancer Fatalities x 10^{-4}
Seattle, Washington	73.10	5.61	0.72
Portland, Oregon/ Vancouver, Washington	87.60	6.60	1.19
Portsmouth, Virginia	1030.00	78.00	3.16

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U.S. DEPARTMENT OF ENERGY
FINDING OF NO SIGNIFICANT IMPACT
SHIPMENT OF LOW ENRICHED URANIUM BILLETS TO THE
UNITED KINGDOM FROM THE HANFORD SITE, RICHLAND, WASHINGTON

AGENCY: Department of Energy

SUBJECT: Finding of No Significant Impact

SUMMARY: The Department of Energy (DOE) has prepared an Environmental Assessment (EA), DOE/EA-0787, for the transfer of 2,592 low enriched uranium billets, currently stored at the 300 Area of the Hanford Site, to the United Kingdom. Based on the analyses in the EA, DOE has determined that the proposed action is not a major Federal action significantly affecting the quality of the human environment, within the meaning of National Environmental Policy Act (NEPA) of 1969. Therefore, an environmental impact statement is not required, and the Department is issuing this Finding of No Significant Impact (FONSI).

PUBLIC AVAILABILITY:

Copies of this EA (DOE/EA-0787) are available from:

Mr. J. E. Mecca, Director
Operations Division
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P. O. Box 550
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BACKGROUND: The United Kingdom has expressed a need for 2,592 low enriched uranium billets (326 metric tons of uranium). The United Kingdom's need for the billets is associated with their Defense Nuclear Program which is ongoing under the auspices of an agreement between the United States of America and the United Kingdom (UK).

The billets, currently stored at the 300 Area of the Hanford Site, Richland, Washington, were fabricated for the manufacture of fuel by the Hanford N Reactor, but are now surplus due to the discontinued defense reactor operations at Hanford. The billets are composed of 99.05% U-238 and other trace isotopes by weight and 0.95% U-235 by weight, weigh an average of 280 pounds (127 kg) each and are approximately 20 inches (508 mm) in length, 5 inches (127 mm) in diameter, with an axial hole which measures 1.25 inches (32 mm) in diameter. The billets are categorized as type X09 and N09 depending on their size and curie content. The 2,592 uranium billets would include 1,887 billets of the type X09 and 705 billets of the type N09. The billets contain a total of 249 curies of uranium and of trace amounts of technetium, the latter's presence being the result of using recycled uranium during the billet's manufacturing process. The type X09 billets account for 183 curies and the type N09 billets account for the remaining 66 curies.

PROPOSED ACTION: The proposed action would include loading billets into closed-type International Standards Organization (ISO) containers, transporting the ISO containers 215 miles (344 km) by truck to the Port of Seattle, Washington, transferring the ISO containers aboard an ocean cargo vessel, and transporting the ISO containers to the UK. The UK would take title to the uranium billets prior to departure from the Hanford Site's 300 Area and would be responsible for all subsequent transportation to the receiving site in the UK.

The tasks associated with the proposed action activities have been performed before and are well defined in terms of requirements and consequences. A risk assessment and a nuclear safety evaluation were performed to address safety issues associated with the proposed action. The risk assessment determined the exposure risk from normal operation and from the maximum credible accident (the most severe reasonably foreseeable accident that is not so remote or conjectural as to preclude meaningful consideration by DOE). This accident involves a truck or ship collision followed by a fire that engulfs all the billets in the shipment and the release of the radiological contents of the shipment to the environment. The safety evaluation determined the nuclear safety limits for loading, transporting and storing the shipment under normal loading conditions, incident-free and accident transport conditions.

ENVIRONMENTAL IMPACTS: The primary impact from the proposed action has been determined to be the occupational radiation exposure that would be received by workers during the performance of the proposed action activities.

The DOE contractor workers would be responsible for the performance of the proposed action's loading activities. The loading activities would consist of placing the special pallets into 29 ISO containers. The ISO containers have a capacity of 10 pallets and the special pallets are designed to carry 9 drums. Each drum contains one low enriched uranium billet. The loading activities and the training of workers in the operation of the equipment would be conducted in the loading staging area of the 313 Building.

The worker radiation exposure dose rate for the activities performed in the 313 Building would be 0.50 mrem/hr. This dose rate includes the building's work areas dose rate and the drum's dose rate at a distance of one meter from the drum. No extraordinary exposure reduction actions are planned at the present time because of the low expected radiation dose rates resulting from the performance of these activities. Cumulative radiation exposure for each individual worker would be tracked daily and actions would be taken, as appropriate, to maintain the radiation exposures to As Low As Reasonably Achievable (ALARA) levels.

Calculations were performed to estimate the potential radiological consequence resulting from the performance of the loading activities for the 2,592 billets. The results of the calculations indicate that under normal loading conditions the exposure consequence resulting from implementing the loading activities of the proposed action would be a collective dose equivalent of 1.0×10^{-1} person-rem to the DOE contractor workers. Based on a conversion factor used by the EPA in a recent rulemaking, the collective dose equivalent of the 1.0×10^{-1} person-rem estimated above would result in 4.0×10^{-5} latent cancer fatalities (LCF). These results and the small number of workers involved (2 persons) lead to the conclusion that no latent cancer fatalities associated with the proposed action would be expected over the workers' lifetimes. No radiation exposure, and therefore no health effects, would be received by the general public during loading because the work area is restricted to DOE contractor workers only.

Under accident loading conditions, several accident scenarios were postulated and evaluated that could cause a radiological release to the environment, but none were found to be reasonably foreseeable. Therefore, it is not expected that there could be any accident during the performance of the loading activities that would result in radiation exposure to DOE contractor workers or the general public.

Risks to DOE contractor workers from other hazards, such as weather exposure, heat exhaustion, and falls or trips, were also considered. These hazards would be minimized by the routine DOE contractor industrial safety programs and the training each worker receives before working at the facility. Dust and noise normally associated with these activities would not exceed industrial standards, and workers would use protective clothing and equipment to minimize safety hazards in accordance with established DOE contractor practices and procedures.

The performance of the loading activities would not generate any nonhazardous/nonradioactive solid waste; nonhazardous/low-level radioactive solid waste; hazardous; or mixed waste. No water emissions, radionuclide or hazardous material releases to the atmosphere would result from the performance of these activities.

The UK would be responsible for the transportation activities and for ensuring that the transportation activities are performed in compliance with the Federal Motor Carrier Safety Regulations and international transportation laws. These activities would include transporting the 2,592 low enriched uranium billets from the Hanford Site to the UK via the Port of Seattle, Washington. The 29 ISO containers would be transported by truck (one ISO container per truck) to the Port of Seattle, Washington. Following the transfer to an ocean cargo vessel, the ISO containers would be transported to the UK. A maximum of 4 ocean trips are planned to transport the 29 ISO containers to the UK.

Using the RADTRAN computer code to determine the transportation risks associated with truck and ocean cargo vessel shipments, a risk assessment was performed to estimate the potential radiological exposure and nonradiological risks resulting from the performance of the transportation activities for the 2,592 billets. The assessment indicates that under incident-free transport conditions, the exposure risk resulting from implementing the transportation activities of the proposed action would be 50.40×10^{-2} person-rem (201.60×10^{-6} LCF) to the UK's workers and contractors and 1.36×10^{-2} person-rem (5.44×10^{-6} LCF) to the general public as a result of the transfer.

A maximum credible accident was postulated specifically for the transportation activities of the proposed action. The accident consists of a truck or ship collision which engulfs the entire cargo of billets (90 billets in 1 ISO container per truck collision; 720 billets in 8 ISO containers per ship collision) in a fire, thus providing the maximum radiological release to the public. It should be noted that this accident is dependent on the number of ISO containers that the truck or ship would transport, not on the total number of billets being transferred under the proposed action. The results of the risk assessment indicate the entire population would be subject to a risk of 31.80 person-rem (127.20×10^{-4} LCF) as a result of such an accident.

The probability of an accident on the high seas with no release of radioactive material to the environment has been identified to be between 1.53×10^{-8} and 3.05×10^{-8} accidents per kilometer. These rates equate to a maximum of 1.59×10^{-5} accidents per ocean shipment or 6.37×10^{-5} accidents for the entire transfer. However, since such an accident would not result in the release of any radionuclide material to the environment, the injuries and fatalities associated with this type of accident are not considered a radiological risk but a nonradiological risk.

The probability of an accident on the high seas which results in the release of radioactive material to the environment has been defined to be between 1.00×10^{-9} and 1.00×10^{-10} accidents per kilometer. These rates equate to a maximum of 5.22×10^{-7} accidents per ocean shipment or 20.88×10^{-7} accidents for the entire transfer. In the unlikely event of such an accident, the volume of material that could be released from the shipping containers is small relative to the volume of ocean water, and hence, dilution and dispersion would be significant. Therefore, the risk to the population due to transport on the high seas is not a significant contributor to the total risk.

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The total radiological exposure risk to the population from the transportation activities would be the sum of the risks estimated under the incident-free transport and accident conditions. Accordingly, the total radiological risk to the population would be 32.32 person-rem (129.27 x 10^{-4} LCF) as a result of the transfer.

Nonradiological risks are the possibilities of injuries and fatalities that could result from traffic accidents and routine exhaust emissions during the highway and ocean transit of the billets. The results of the risk assessment indicate that the implementation of the proposed action could result in 7.31 x 10^{-3} injuries and in 5.61 x 10^{-4} fatalities as a result of the transfer. These results include the injuries and fatalities associated with an accident which occurs under incident-free transport conditions. The results further indicate that the exhaust emissions from the transport trucks could contribute 0.72 x 10^{-4} LCF. Based on these results, no latent cancer fatalities associated with the transportation activities of the proposed action are expected over the lifetime of the population.

A nuclear safety evaluation was also performed to determine if the uranium billet shipments have sufficient controls and safety factors to prevent a nuclear chain reaction under normal loading conditions, incident-free, and accident transport conditions. The results indicate that there are sufficient controls and safety factors to prevent a nuclear chain reaction under the above conditions.

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